1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Camas Creek Subbasin that have been placed on what is known as the "§303(d) list."

The overall purpose of this subbasin assessment and TMDL is to characterize and document pollutant loads within the Camas Creek Subbasin. The first portion of this document, the subbasin assessment, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Sections 1 – 4). This information will then be used to develop a TMDL for each pollutant of concern for the Camas Creek Subbasin (Section 5).

1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses. These requirements result in a list of impaired waters, called the "§303(d) list." This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A subbasin assessment and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. *Camas Creek Subbasin Assessment and TMDL* provides this summary for the currently listed waters in the Camas Creek Subbasin.

The subbasin assessment section of this report (Sections 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Camas Creek Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (Water quality planning and management, 40 CFR 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as "pollution." TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified

- Contact recreation – primary (swimming), secondary (boating)

- Water supply – domestic, agricultural, industrial

- Wildlife habitats, aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are used as additional default designated uses when water bodies are assessed.

A subbasin assessment entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.
- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The Camas Creek Subbasin runs from the headwaters of Camas Creek (west of Packer Butte in the Camas Prairie of Elmore County) to its mouth, where the creek empties into Magic Reservoir. The subbasin lies along the western border of the Upper Snake River Basin in Idaho, with the Big Wood River and Upper Snake-Rock Subbasins surrounding it. The southern border of the Camas Subbasin runs from the mouth of Camas Creek, in a southwest direction along the southern edge of Macon Flat, then west within the Camas Prairie along the northern edge of the Mount Bennett Hills to the headwaters. From here, the Camas Creek Subbasin begins to run in a northeast direction, moving gradually into the Sawtooth National Forest. The northern border runs above Smoky Dome and Cannonball Mountain and then further north along Willow Creek to the Camas County Line. From here, the eastern border runs in a southeast direction along the county line, then just south of the Kelly Mountains, continuing southeast to the mouth of Camas Creek.

Climate

The Camas Creek Subbasin can be divided into two elevation ranges. The low elevation range is equal to or less than 5,250 feet (this accounts for the valley floor and 48.1% of the subbasin area), while the high elevation range is greater than 5,250 feet (51.9% of the subbasin area) (ArcView Coverage 1992-1996). These elevation ranges were used in describing much of the climate of the subbasin. Air temperature, snowfall, and snow depth data have been collected from similar data sources and elevations. The low elevation data is an average of data from three sites within the subbasin at this elevation range. The low elevation sites include two Fairfield sites and Hill City. The high elevation data is collected from one site, Soldier Ranger Station.

Precipitation

The weighted mean precipitation for the Camas Creek Subbasin is 18.8 inches (WRCC 2001, NRCS 2001a). The majority of the precipitation occurs in the winter and spring months. Table 4 describes seasonal precipitation data for the elevation ranges.

Table 4. Average precipitation (inches) in the Camas Creek Subbasin.

Elevation	Winter Average	Spring Average	Summer Average	Fall Average	Total Annual
Upper	3.5	2.1	0.6	1.5	23.1
Lower	1.9	1.2	0.6	1.1	14.2

[a]Data collected from Western Regional Climate Center (WRCC) and U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Web sites.

Air Temperature and Available Sunlight

The highest monthly average maximums and minimums for temperature occur in the summer months, especially July. The lowest monthly average maximums and minimums for temperature occur in the winter months, most notably in January (WRCC 2001, NRCS 2001a). Table 5 describes the estimated midrange temperatures for the low and high elevations of the subbasin.

Table 5. Camas Creek Subbasin air temperature.

Elevation Range	Midrange Temperature (º C)	Midrange Temperature (º F)
Upper	-4.96 to 17.65	23.07 to 63.77
Lower	-8.19 to 17.78	17.25 to 64.00

[a]Data collected from Western Regional Climate Center (WRCC) and U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Web sites.

The estimated average annual available sunlight for this region is 12.9 hours, with the greatest amount of average available light occurring in the summer months at 14.0 hours, and the least amount occurring in the winter months at 10.2 hours (USNO 2001).

Snow Depth and Snowfall

The lower elevations of the Camas Creek Subbasin receive an average total snowfall of 66 inches. The majority of this snowfall occurs from December to February, when the average snow depth for the low elevations is 13.5 inches.

The majority of this snowfall in the upper elevation range occurs from January to April, when the average snow depth for the high elevations is 29.5 inches (WRCC 2001).

Evaporation and Wind Erosion

The annual evaporation for the Camas Creek Subbasin is 6 *millimeters per month* (mm/month), with the majority of evaporation occurring in the months of May through September (CPC 2001). The largest amount of evaporation occurs in June and July with 20 mm/month.

Wind erosion in the Camas Creek Subbasin has been found to be so minimal as to be insignificant in its effect on the water quality of the water bodies. It has been estimated that only 3.35% of the subbasin area exceeds the threshold for wind erosion (NRCS 2001b).

Subbasin Characteristics

The Camas Creek Subbasin has its main water body, Camas Creek, lying in the flat and lower elevations of the Camas Prairie. Many of the Camas Creek tributaries originate in the higher mountainous and foothill elevations; they then flow down through the flat prairie region of the subbasin before emptying into Camas Creek.

Hydrography

A number of natural and anthropogenic activities or conditions occur in the Camas Creek Subbasin that impact the hydrology of the subbasin. Figure 3 depicts the average annual hydrograph for several of the water bodies (this data includes flow data collected from 1970 to 2003).

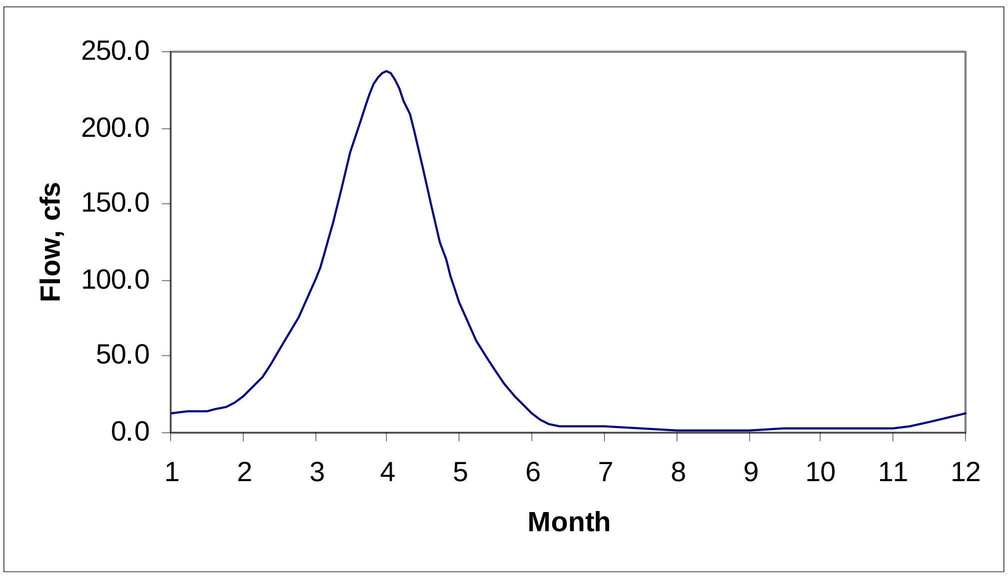


Figure 3. Camas Creek Subbasin average hydrology.

Spring runoff in the subbasin is early and rapid. The majority of the flow occurs in March and April. Less than 1 cubic feet per second (cfs) of flow occurred in July, August, September, and November.

A number of streams are dry throughout the summer and into the spring months in the lower prairie reaches of the water body, and a few water bodies have small segments that are perennial due to ground water influences (water tables and beaver dams) despite the remainder of the water body being dry. The hydrology of the individual water bodies within the subbasin is discussed in Section 2: Subbasin Assessment – Water Quality Concerns and Status, page 33.

Camas Creek is the natural outlet for all of the water of the Camas Creek Subbasin, although there are seven water bodies that retain some of the water of the subbasin. These water bodies include Mormon Reservoir, Macon Lake, Kelly Reservoir, Spring Creek Reservoir, McHan Reservoir, Negro Creek Reservoir, and Cow Creek Reservoir. All of these reservoirs, except Macon Lake, are privately owned.

The predicted hydrographs of Camas Creek and its tributaries were developed from *United States Geological Survey* (USGS) gauge data and flow records collected by DEQ and other agencies. To date there is one active gauge station in the Camas Creek Subbasin, USGS 13141500 Camas Creek near Blaine Idaho (Figure 4). ArcView coverage identifies one other gauge in the subbasin, however, this station no longer exists and/or recorded data has not been located (ArcView Coverage 1992-1996).

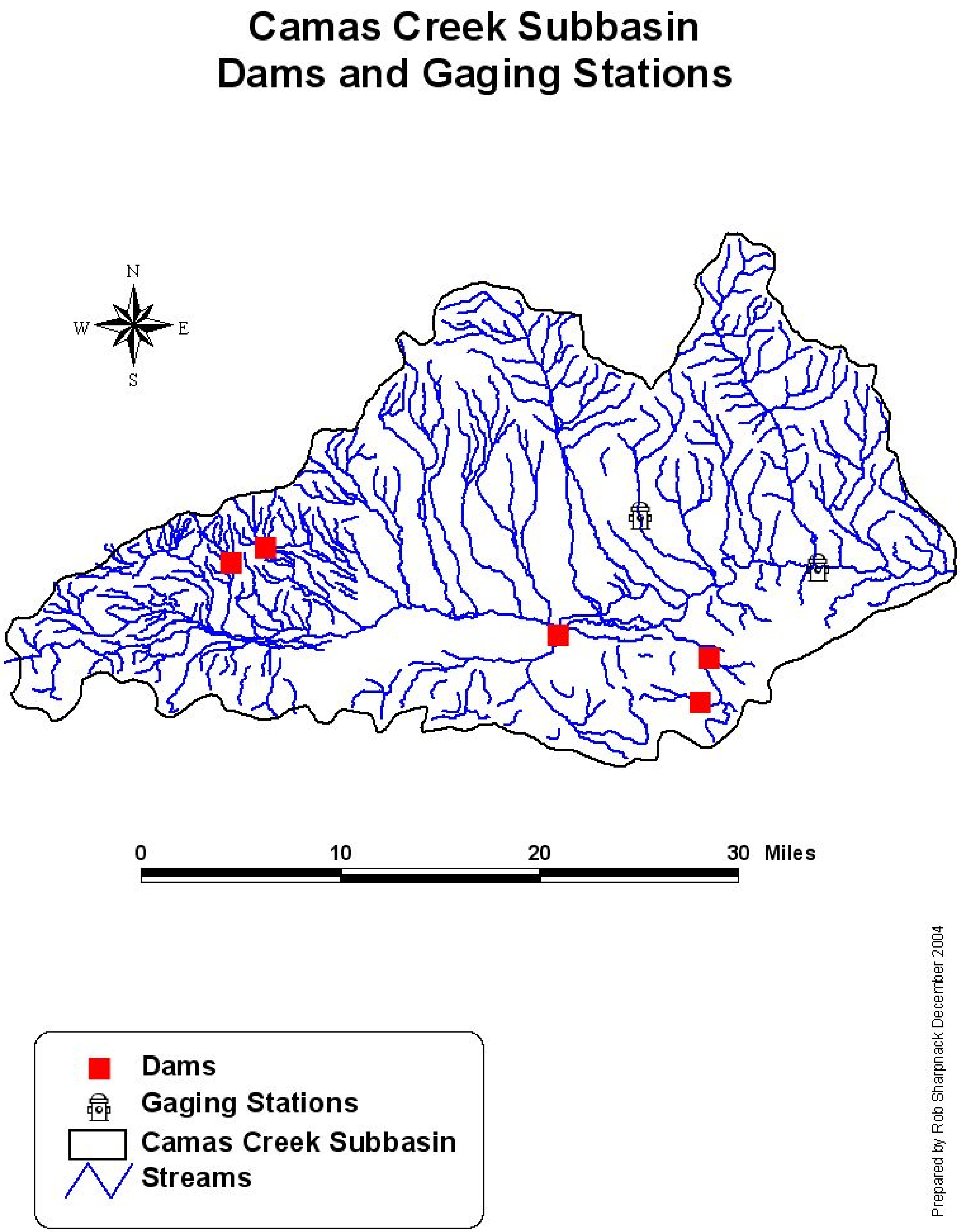


Figure 4. Dams and gauging stations in the Camas Creek Subbasin.

Geology and/or soils

The Camas Creek Subbasin consists of two ecoregions: Snake River Basin/High Desert and Northern Rockies. The Northern Rockies ecoregion exists in the northern region of the subbasin and covers 24.7% of the subbasin area. The Snake River Basin/High Desert ecoregion exists in the middle and southern portion of the subbasin and covers 75.3% of the subbasin area. (ArcView Coverage, 1992-1996). There exist transitional zones between the two ecoregions, but these make up only a very small portion of the area.

There are three geomorphology types in the Camas Creek Subbasin. The high mountainous elevations are alpine glacial (erosional), while the hills to the north and south of the subbasin are fluvial. Finally, the prairie area of the Camas Creek Subbasin is plateau (ArcView Coverage, 1992-1996).

There are 15 different geologic formations in the Camas Creek Subbasin (Table 6 and Figure 5). The central portion of the Camas Creek Subbasin consists of Quaternary alluvium (29.5% of the area) and Middle Pleistocene plateau and canyon filling basalt (18.8% of the area). The northern regions of the subbasin have mostly Cretaceous plutons (21.4% of the subbasin area) and Eocene mixed silicic and basaltic volcanic ejecta flows, which occur in 12.6% of the subbasin area. The southern portion of the subbasin, which lies below Camas Creek, has various different formations in small, scattered quantities (ArcView Coverage, 1992-1996).

Table 6. Geologic formations of the Camas Creek Subbasin.

Name	Description	Area (km^2)	Percent of subbasin
Ki	Cretaceous plutons	124.8	7.0
Ki?	Cretaceous plutons	26.9	1.5
Kii	Cretaceous plutons-intermediate	227.9	12.9
OW	Open water	10.4	0.6
PPNc	Lower Permian to Middle Pennsylvanian thrusted marine detritus	24.9	1.4
Qa	Quaternary alluvium	523.4	29.5
Qg	Quaternary colluvium fanglomerate and talus	3.6	0.2
Qp?g	Pleistocene outwash fanglomerate flood and terrace gravels	32.4	1.8
Qpmb	Middle Pleistocene plateau and canyon-filling basalt in and near Snake Plains	332.8	16.8
Qpmg	Middle Pleistocene deposits	58.8	3.3
Qpug	Upper Pleistocene deposits	2.1	0.1
Tei	Eocene intrusions	36.0	2.0
Tev	Eocene mixed silicic and basaltic volcanic ejecta flows and reworked debris	223.3	12.6
Tpb	Pliocene olivine basalt flows and associated tuff and detritus	47.4	2.7
Tpf	Pliocene silicic welded tuff ash and flow rocks	97.1	5.5

[a]Data from ArcView Coverage 1992-1996.

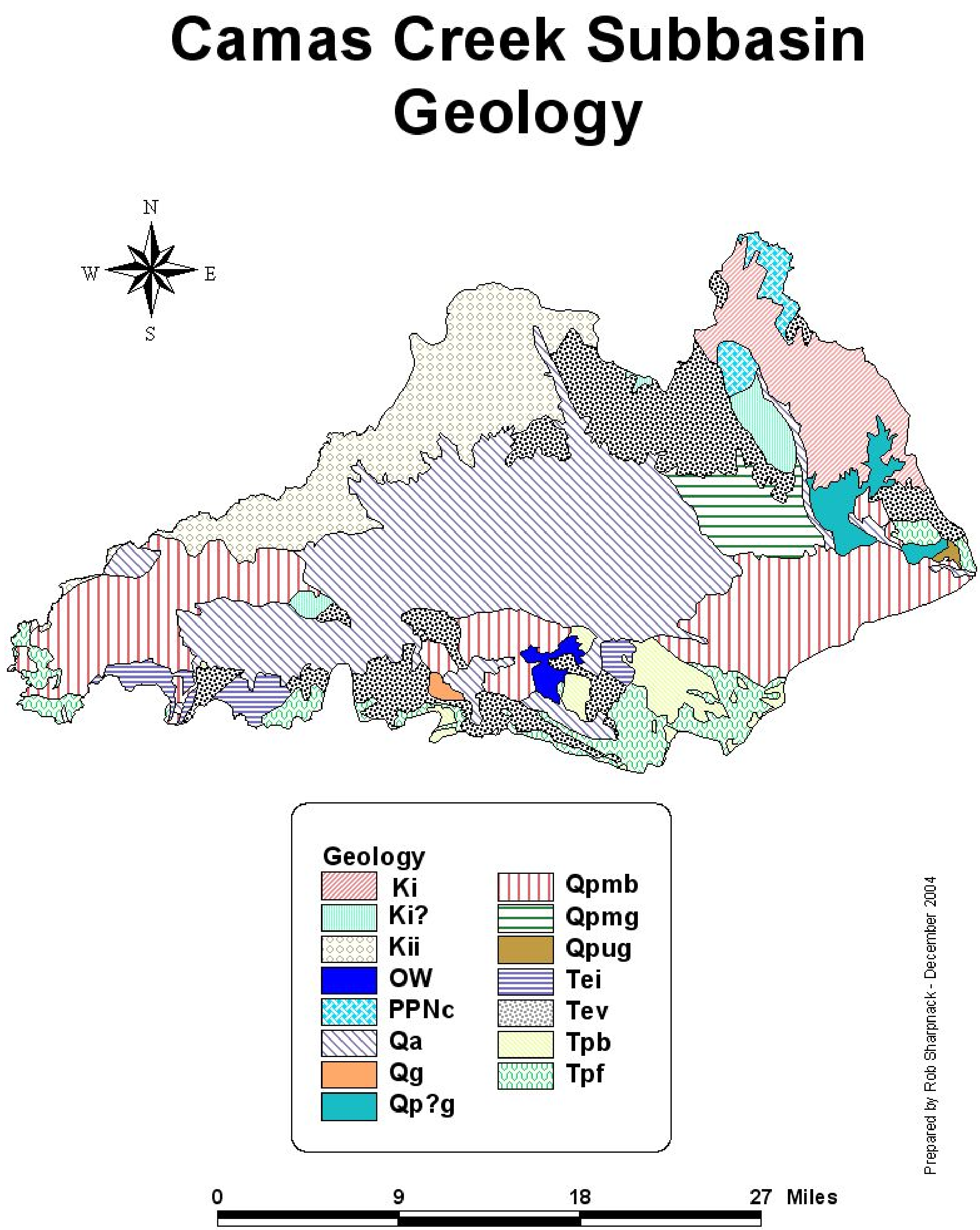


Figure 5. Geologic formations of the Camas Creek Subbasin.

K factor is a measure of the susceptibility of soil to erosion and runoff . Soils with K factor values of 0.05 to 0.15 are resistant to detachment; soils with K factor values of 0.05 to 0.2 tend to be easily detached but have low runoff. Soils with higher K factors of 0.25 to 0.4 are moderately susceptible to detachment and have moderate runoff. Soils with K factors of 0.4 or greater are easily detached and have high rates of runoff (MSU 2005).

The majority of the subbasin has soil K factors of 0.25 to 0.35 (Figure 6); these soils lie along the Camas Prairie and flood plains of many of the streams. Soils with K factors of 0.15 to 0.25 lie in the upper portions of the subbasin in the headwater stretches of many of the creeks in the subbasin. Finally, there are two smaller patches of soil in the headwater stretches of the Soldier and Willow Creek drainages that have K factors of 0-0.08 and 0.35 to 0.45 (ArcView Coverage 1992-1996).

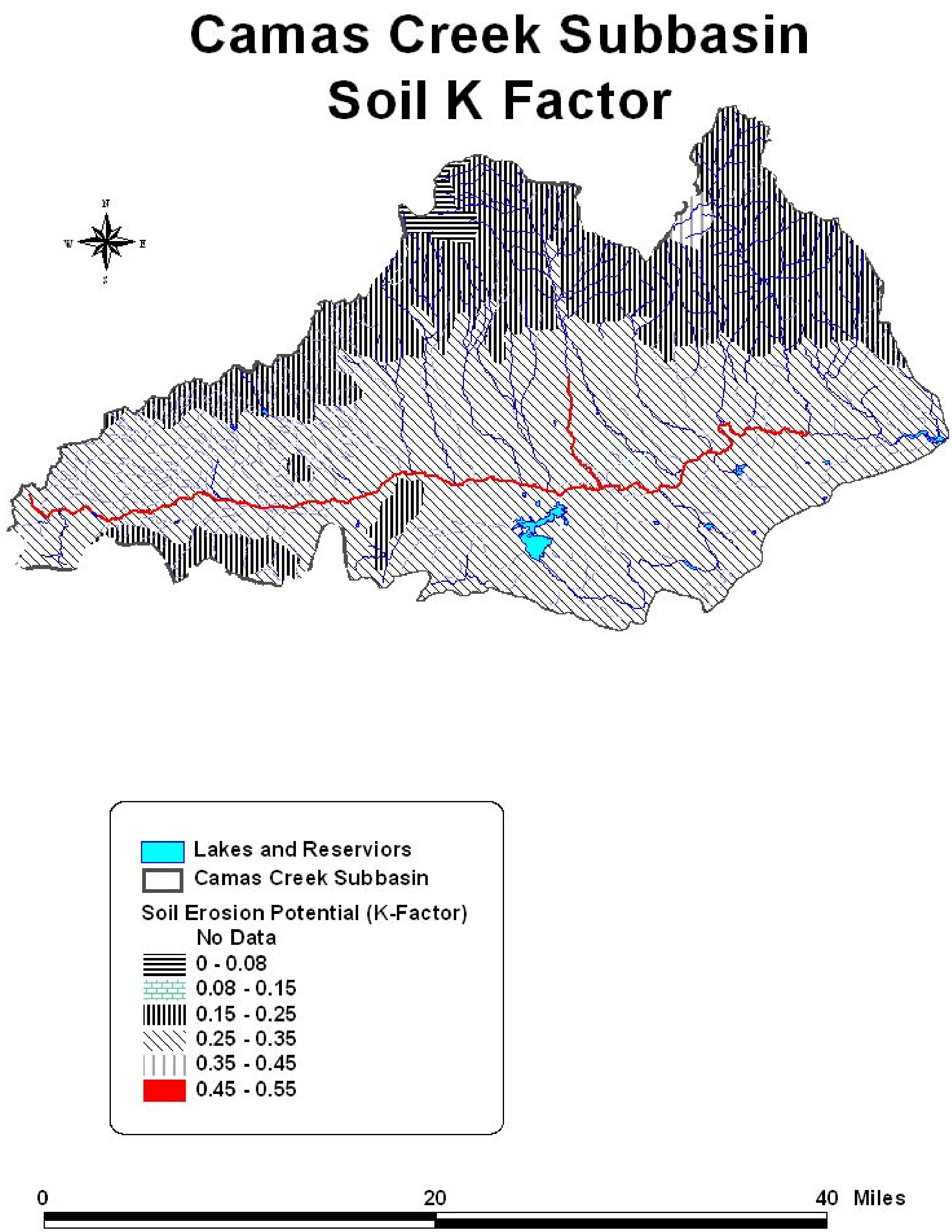


Figure 6. Soil erosivity (K factors) of the Camas Creek Subbasin.

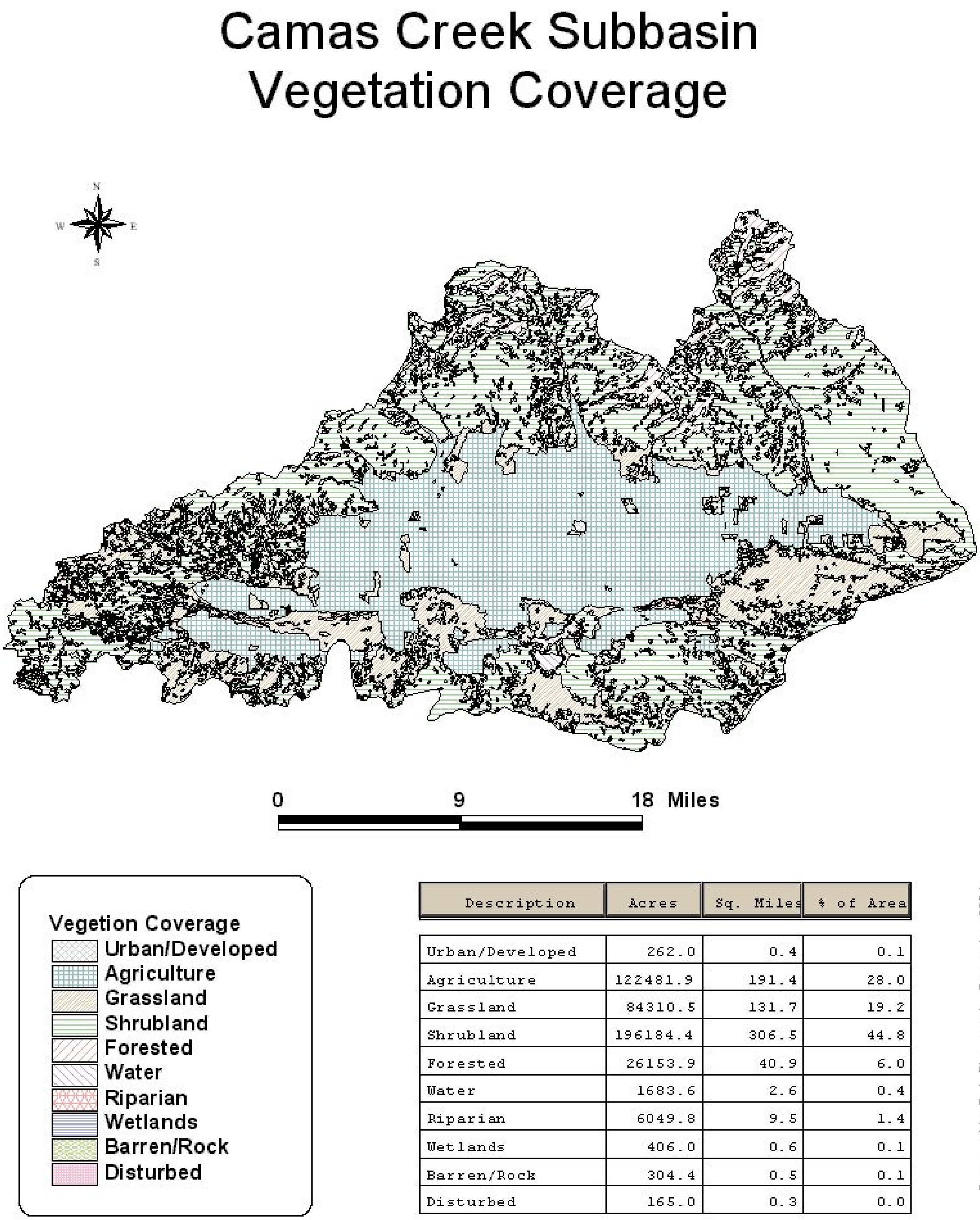
Topography

Two different elevation ranges characterize the Camas Creek Subbasin: the lower elevation range is less than or equal to 5,250 feet while the higher elevation is greater than 5,250 feet. Most of the mountains lie to the north, at elevations around 7,000 to 8,000 feet. Near the headwaters of Willow Creek and those of the Soldier Creek Forks are the highest elevations, ranging from 8,000 to 11,000 feet (ArcView Coverage, 1992-1996). The lowest elevation in the Camas Creek Subbasin is at the mouth of Camas Creek at 4,800 feet. Some of the peaks of the subbasin occur at Liberal and Cannonball Mountain (8,200 feet), Kelly Mountain (8,700 feet), and Smoky Dome (10,000 feet).

Camas Creek flows from west to east through the Camas Prairie. The Camas Creek Subbasin extends from the mouth, which empties into the Magic Reservoir to the basin divide line, which extends about a mile beyond the headwaters. The subbasin length is about 55 miles long and has an elevation difference of 945 feet. These characteristics yield a subbasin slope of about 0.33%.

Vegetation

The Camas Creek Subbasin vegetation consists mainly of agriculture, grassland, and shrubland (Figure 7). There is very little (2.1 % of the area) urban/developed, water, riparian, wetland, barren/rock, and disturbed vegetation in this subbasin. Agriculture vegetation accounts for 28% of the subbasin area and occurs in the center of the subbasin. Grassland occurs in 19.2% of the area and is found dispersed around the edges of the agriculture vegetation, but mostly to the south. Shrubland covers the remainder of the area at 44.8%, with a little bit of forested vegetation (6.0%) occurring in the north region (ArcView Coverage, 1992-1996).



Description	Acres	Sq. Miles	% of Area
Urban/Developed	262.0	0.4	0.1
Agriculture	122481.9	191.4	28.0
Grassland	84310.5	131.7	19.2
Shrubland	196184.4	306.5	44.8
Forested	26153.9	40.9	6.0
Water	1683.6	2.6	0.4
Riparian	6049.8	9.5	1.4
Wetlands	406.0	0.6	0.1
Barren/Rock	304.4	0.5	0.1
Disturbed	165.0	0.3	0.0

Prepared by Rob Sharpnack - December 2001

Figure 7. Vegetation coverage of the Camas Creek Subbasin.

Biological Communities

The presence of endangered, threatened, or sensitive species can impact the way in which the land of the subbasin is managed. There are a number of endangered, threatened, or sensitive species within the counties of the Camas Creek Subbasin (Appendix 2). These species are a concern within the counties but not necessarily found within the subbasin itself (USFWS 2001).

Some of these species are aquatic or depend upon the aquatic environment at some point in their life cycle. The bald eagle winters and nests in the area and feeds on fish within the streams. Some species of concern found within the subbasin are redband trout and Wood River sculpin. Bull trout are listed as a threatened species in Blaine, Camas, and Elmore Counties, but they do not occur within the Camas Creek Drainage (Warren 2001).

Fisheries can be a good indicator of the water quality status of a water body since the thermal requirements of fish have been fairly well studied (Grafe et al 2002). Fish in the northwest are identified as cold, cool, or warm water species and can be classified with overall pollution tolerance values of sensitive, tolerant, or intermediate (Zaroban et al 1999). There are many species of fish that are found within the waters of the Camas Creek Subbasin. The fish in the subbasin are identified, along with their temperature preference and tolerance values in Table 7.

Table 7. Fisheries of the Camas Creek Subbasin.

Family	Species	Temperature Preference	Tolerance value
Salmonidae	Rainbow trout	Cold water	S
	Brook trout	Cold water	I
Cottidae	Wood River sculpin	Cold water	S
	Sculpin sp		
Catostomidae	Sucker sp	Cool water	
	Mountain sucker	Cool water	I
Cyprinidae	Dace sp	Cool water	
	Speckled dace	Cool water	I
	Redside shiner	Cool water	I

[a]Species accumulated through various collection events.
[b]S-Sensitive, I-Intermediate, T-Tolerant.

The Wood River sculpin is a cold water species that is sensitive to pollution and endemic to the Wood River Drainage. The *Idaho Department of Fish and Game* (IDFG) consider it to be a species of special concern and the U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) consider it to be a sensitive species. These classifications are a result of the lack of knowledge about the range of the species, the land management impacts to the habitat of the Wood River sculpin, and the impacts to the species from competitive species (Zaroban 2003). These characteristics could make this species an excellent indicator of water quality trends within the subbasin if intensive surveys were completed in the Wood River Drainage.

Benthic macroinvertebrates have limited migration patterns, which makes them good indicators of environmental conditions (Grafe et al 2002). An analysis of the macroinvertebrates on the 303(d) listed streams was performed, yielding the following results:

- The Stream Macroinvertebrate Index (SMI), the average of nine metric indices, is an overall indicator of the health of a stream. A large group of sites rated good, however the majority of the sites rated as fair, poor and very poor.
- Taxa richness is a metric that measures the health of the community by a measure of the variety of taxa present. Generally, as habitat quality increases so too does taxa richness. Taxa richness of the listed streams in the Camas Creek Subbasin were low in comparison to other studies completed in southern Idaho.
- The pollution tolerance value indicates how tolerant a species is to pollution and ranges from 0 to 11. A lower number indicates intolerance. The majority of the sites rated as good, fair, and fairly poor for pollution tolerance values.
- The numbers of Ephemeroptera and Plecoptera taxa are metrics than can indicate temperature and fine sediment pollution. As the number of these taxa increase so too does water quality. This index score in the subbasin ranged from 0 to 77%.
- The percent scrapers metric decreases as fine sediment increases within a system. The percent clingers metric decreases as habitat disturbance increases. The number of scraper and clinger taxa within the subbasin was low.
- Low numbers of cold water taxa indicate that land use and pollutants are impacting a water body. The number of cold water taxa and their abundance were depressed in the subbasin.

Overall, the macroinvertebrate data in the Camas Creek Subbasin seem to indicate that the water bodies in the subbasin appear to be impacted by fine sediment and temperature (Clark 2003).

The following table also identifies the assessment units within the subbasin and their beneficial use support status.

Table 8. Assessment units of the subbasin and their beneficial use status.

Assessment unit	Assessment Name	Status	Creeks with data	Year of data	Notes
ID17040220SK001_02	Camas Creek-Elk Creek to Magic Reservoir	Not assessed	Poison	2001	Dry
ID17040220SK001_05	Camas Creek-Elk Creek to Magic Reservoir	Not supporting	Camas	1995	
ID17040220SK002_02	Camp Creek-source to mouth	Not supporting	Camp	1996, 2001	Dry (2001)

Assessment unit	Assessment Name	Status	Creeks with data	Year of data	Notes
ID17040220SK002_03	Camp Creek-source to mouth	Not supporting	No sites		
ID17040220SK003_02	Willow Creek-Beaver Creek to mouth	Not assessed	No sites		
ID17040220SK003_04	Willow Creek-Beaver Creek to mouth	Not supporting	Willow	1993, 1995	
ID17040220SK004_02	Beaver Creek-source to mouth	Full support	Beaver, Little Beaver	1993, 1995, 1997, 2001	
ID17040220SK004_03	Beaver Creek-source to mouth	Full support	Beaver Creek	1997	
ID17040220SK005_02	Willow Creek-source to Beaver Creek	Full support	West Fork Willow, Willow, Devils Dive, Buttercup, Cherry	1993, 1995, 2001	Devils Dive Dry (2001)
ID17040220SK005_03	Willow Creek-source to Beaver Creek	Not assessed	Willow	2001	
ID17040220SK006_02	Elk Creek-source to mouth	Not supporting	Elk	2001, 1993	Dry (2001)
ID17040220SK007_02	Camas Creek-Soldier Creek to Elk Creek	Not assessed	Knowlton	2001	Dry
ID17040220SK007_05	Camas Creek-Soldier Creek to Elk Creek	Not supporting	Camas	1995	
ID17040220SK008_02	Deer Creek-Big Deer Creek to mouth	Not assessed	Daugherty	2001	Dry
ID17040220SK008_03	Deer Creek-Big Deer Creek to mouth	Not assessed	Deer	1996	Dry
ID17040220SK008_04	Deer Creek-Big Deer Creek to mouth	Not assessed	No sites		
ID17040220SK009_02	Deer Creek-source to and including Big Deer Creek	Not assessed	Little Deer	2001	Dry
ID17040220SK010_02	Powell Creek-source to mouth	Not assessed	Powell	2001	Dry
ID17040220SK011_02	Soldier Creek-Wardrop Creek to mouth	Not supporting	No sites		
ID17040220SK011_03	Soldier Creek-Wardrop Creek to mouth	Full support	Soldier	1993, 1995	
ID17040220SK012_02	Soldier Creek-source to and including Wardrop Creek	Full support	North Fork Soldier, Reedy, Owens, Lawrence, Wardrop, Sampson	1995, 2001	Reedy, Owens, Lawrence Dry (2001)
ID17040220SK012_03	Soldier Creek-source to and including Wardrop Creek	Not assessed	South Fork Soldier	2001	
ID17040220SK013_02	Camas Creek-Corral Creek to Soldier Creek	Not assessed	McCan Gulch Creek	2001	Dry
ID17040220SK013_03	Camas Creek-Corral Creek to Soldier Creek	Not assessed	East Fork Threemile	1996	Dry
ID17040220SK013_05	Camas Creek-Corral Creek to Soldier Creek	Not supporting	Camas	1993, 1995, 2001	Dry (2001)

Assessment unit	Assessment Name	Status	Creeks with data	Year of data	Notes
ID17040220SK014_02	Threemile Creek-source to mouth	Not assessed	West Fork Threemile, McMahan, Threemile	1996, 2001	Threemile Dry (1996,2001)
ID17040220SK015_03	Corral Creek-confluence of East Fork and West Fork Corral	Not supporting	Corral	1993	
ID17040220SK016_02	East Fork Corral Creek-source to mouth	Full support	Rough, East Fork Corral	1993, 1994, 1996	
ID17040220SK016_03	East Fork Corral Creek-source to mouth	Not assessed	No sites		
ID17040220SK017_02	West Fork Corral Creek-source to mouth	Full support	West Fork Corral	1993	
ID17040220SK018_02	Camas Creek-source to Corral Creek	Not supporting	Cow	1993	
ID17040220SK018_03	Camas Creek-source to Corral Creek	Not supporting	Cow, Camas	1995, 1996, 2001	Cow Dry (1996, 2001)
ID17040220SK018_04	Camas Creek-source to Corral Creek	Not supporting	No sites		
ID17040220SK019_02	Chimney Creek-source to mouth	Full support	Sheep, Chimney	1996, 2001	Sheep Dry (2001)
ID17040220SK019_03	Chimney Creek-source to mouth	Not assessed	No sites		
ID17040220SK019_04	Chimney Creek-source to mouth	Not assessed	Chimney	1996, 2001	Dry (1996, 2001)
ID17040220SK020_02	Negro Creek-source to mouth	Not assessed	Negro	2001	Dry
ID17040220SK020_03	Negro Creek-source to mouth	Not assessed	No sites		
ID17040220SK021_02	Wild Horse Creek-source to mouth	Not assessed	No sites		
ID17040220SK021_03	Wild Horse Creek-source to mouth	Not supporting	Wild Horse	1993, 1996	Dry (1996)
ID17040220SK022_02	Malad River-source to mouth	Not assessed	No sites		
ID17040220SK022_03	Malad River-source to mouth	Not assessed	Malad	2001	Dry
ID17040220SK023_02	Mormon Reservoir	Not assessed	No sites		
ID17040220SK023_03	Mormon Reservoir	Not assessed	No sites		
ID17040220SK023L_0L	Mormon Reservoir	Not supporting	No sites		
ID17040220SK024_02	Dairy Creek-source to Mormon Reservoir	Not supporting	No sites		
ID17040220SK025_02	McKinney Creek-source to Mormon Reservoir	Not supporting	McKinney	1993	
ID17040220SK025_03	McKinney Creek-source to Mormon Reservoir	Not supporting	No sites		
ID17040220SK026_02	Spring Creek Complex	Not assessed	No sites		

Assessment unit	Assessment Name	Status	Creeks with data	Year of data	Notes
ID17040220SK026_03	Spring Creek Complex	Not assessed	Spring	1993	
ID17040220SK027_02	Kelly Reservoir	Not assessed	No sites		
ID17040220SK027L_0L	Kelly Reservoir	Not assessed	No sites		

[a]The above listed information has been accumulated through the IDASA program in May of 2005 and includes biological data collected up to 2001; some assessment statuses may not be reflected in the 1998 303(d) list, but in the more current lists of impaired waters.

Water Chemistry

Seasonal peaks for sediment, nutrients, and bacteria occur in the Camas Creek Subbasin. Historical and recent data were used to determine peak discharge of pollutants in the subbasin. Monthly data from all monitoring sites were averaged together to represent the annual graph for the subbasin.

Suspended load constitutes both washload and suspended bed-material load. Washload comes from the banks and upland areas and can remain in suspension during low velocities. Suspended bed-material load is transported with the washload by turbulent water and will drop out when velocities decrease (Gordon et al., 1992). Sediment in the subbasin was measured in the form of total suspended solids (TSS). Figure 8 depicts the average discharge of TSS in the Camas Creek Subbasin.

There are two peak discharges of TSS, the first peak occurs during the spring runoff months and the second peak occurs in the fall during base flow events. Higher concentration of TSS would be expected during spring runoff as the stream flows would likely be higher and more washload and suspended bed-material would be transported. A peak in the fall is less likely to be expected as velocities are low and are less likely to be carrying suspended bed-material loads. The peak is likely due to anthropogenic activities occurring in the subbasin, although late season precipitation events could also contribute to sediment loads during base flow events.

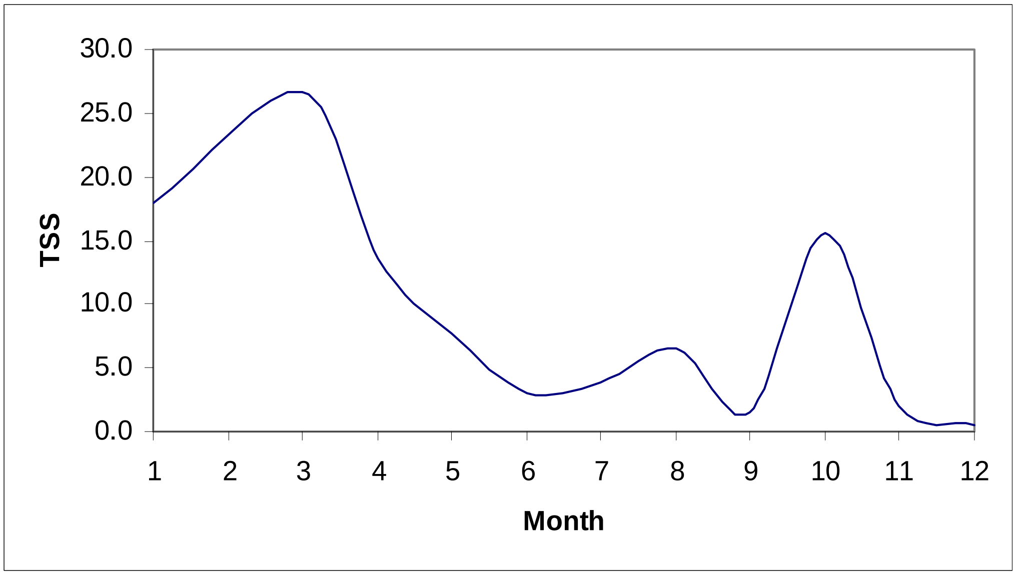


Figure 8. Average annual TSS (mg/L) in the subbasin.

Nitrogen and phosphorous are two components necessary for the growth of aquatic plants within a water body. In most freshwater systems phosphorous is the limiting factor because it has a tendency to bind with other elements or sediment and be taken out of the cycle (Federal Interagency Stream Restoration Working Group, 1998). Nutrients in the Camas Creek Subbasin were measured in the form of total phosphorous (TP).

Figure 9 depicts the average annual discharge of TP in the Camas Creek Subbasin. There is one peak discharge of TP; the event occurs during the spring runoff months and early summer months when flow in the subbasin is highest. Peak discharges of TP in the runoff period would be expected as sediments are generally transported during high flows. The TP quantity would be elevated because TP has a high tendency to bind with sediments, therefore as sediment is transported so too is TP. The TP values throughout the rest of the year are fairly stable.

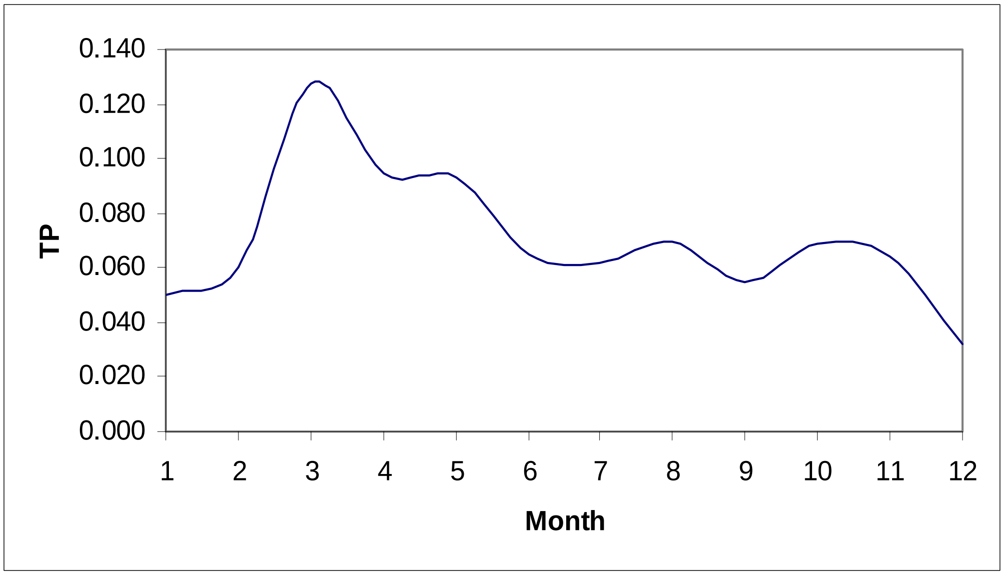


Figure 9. Average annual TP (mg/L) in the subbasin.

There are apt to be fluctuations in the bacteriological content of water in surface waters. These fluctuations tend to occur in the spring and fall when snow melt and rainfall introduce wash from the surrounding lands (Prescott 1931). Bacteria in the Camas Creek Subbasin were measured in the form of *Escherichia coli* (*E.coli*). Figure 10 depicts the average annual discharge of *E. coli* in the subbasin. *There are peaks in E. coli in the subbasin during the summer months.* These peaks are likely due to anthropogenic activities as there is less surface wash from precipitation events during the summer.

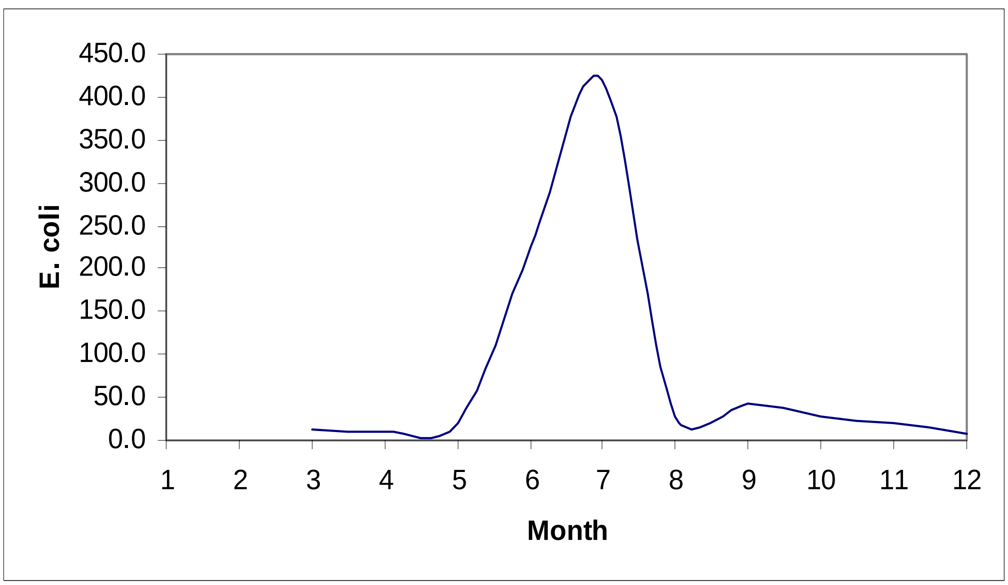


Figure 10. Average annual *E. coli* in the subbasin.

Subwatershed Characteristics

The Camas Creek Subbasin consists of nine watersheds of the 5th field *hydrological unit codes* (HUCs) referred to as *subwatersheds*. The subwatersheds of the subbasin and their attributes are described in the following sections.

5th field Hydrologic Unit Code (HUC)

The Camas Creek Subbasin consists of nine watersheds of the 5th field HUC category (ArcView Coverage 1992-1996). Each of these watersheds drains into the tributaries of Camas Creek or into Camas Creek itself. These watersheds will be the divisions used to aid in the implementation process to clean up the 303(d) listed streams.

Watershed Area

The watershed area is described in Table 9, which is organized by 5th field HUC. These HUCs are also shown in Figure 11.

Table 9. Camas Creek Subbasin 5th field HUC watershed areas.

5th Field HUC	Name	Associated 303(d) Creek	Area (km^2)	Acres	Percent of Area
17040220-01	Upper Magic Reservoir	Camp	147.9	36,546.4	8.3
17040220-02	Willow Creek	Willow, Beaver, and Little Beaver	162.7	40,181.8	9.2
17040220-03	Deer-Kelly-Elk	Elk and Camas	232.3	57,418.8	13.1
17040220-04	Soldier-Spring	Soldier and Camas	309.8	76,534.4	17.5
17040220-05	Corral Creek	Corral and Camas	89.9	22,179	5.1
17040220-06	Mormon Reservoir	Mckinney and Camas	177.9	43,944.5	10.0
17040220-07	Corral-Dairy	None	176.9	43,691.9	10.0
17040220-08	Chimney-Cow	Cow and Camas	180.3	44,538.8	10.2
17040220-09	Upper Camas Creek	Camas and Wild Horse	297.3	73,491.5	16.8

[a]Data from ArcView Coverage 1992-1996.

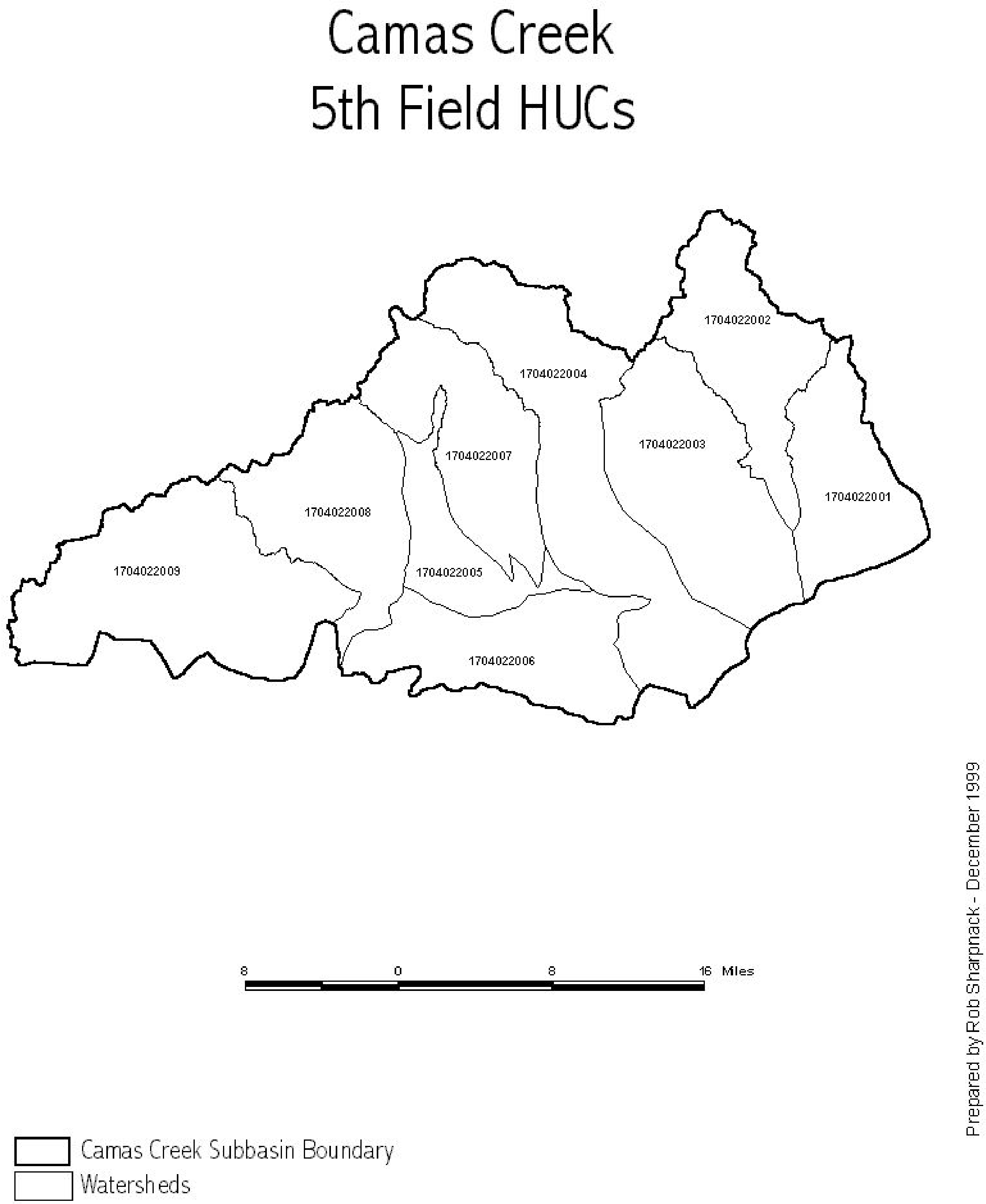


Figure 11. 5th field HUCs for Camas Creek Subbasin.

Watershed attributes can help indicate what factors may be influencing water quality in a given watershed. Table 10 provides information on watershed attributes for the various watersheds of the Camas Creek Subbasin.

Table 10. Camas Creek Subbasin watershed attributes.

5th Field HUC	Land Form	Dominant Aspect	Relief Ratio	Mean Elevation (meters)	Dominant Slope (%)	Hydrologic Regime	Unit Area Runoff (ton/acre/yr)
17040220-01	NR & SRB/HD	N to E	0.047	1713	9.1	REC	51.3
17040220-02	NR & SRB/HD	N to SE	0.045	2009	7.3	DEND	236.2
17040220-03	NR & SRB/HD	N to E	0.050	1716	8.6	REC	84.7
17040220-04	NR & SRB/HD	NW to E	0.047	1873	5.9	DEND + MB	386.7
17040220-05	NR & SRB/HD	N to E	0.019	1591	8.1	REC	20.4
17040220-06	SRB/HD	W to NE	0.029	1653	8.8	CONT	135
17040220-07	NR & SRB/HD	NW to SE	0.059	1846	7.4	PARA	256.5
17040220-08	NR & SRB/HD	N to SE	0.035	1702	9.7	DEND + PARA	152.2
17040220-09	SRB/HD	W to E	0.018	1680	5.7	CON	183.7

[a]Data from Buhidar 2002.
[b]SRB/HD-Snake River Basin/High Desert, NR- Northern Rockies, E-East, W-West, N-North, S-South, CON-contorted, ANN-annual, PARA-parallel, DEND-dendritic, MB-multi-basinal.

Landforms, which have been identified based on ecoregions, are recognizable formations or features of the land that have a characteristic shape and are produced by natural causes (NWOSSP 2004). In the case of watersheds of the Northern Rockies (NR), the landforms that are present are sharp-crested, steep sloped high mountains. For watersheds of the Snake River Basin High Desert (SRB/HD), characteristic landforms are tablelands with moderate to high relief plains (hills or low mountains). Both of these landforms are found throughout the watersheds of the Camas Creek Subbasin.

As can be seen, there are many traits that can characterize a region, and these traits are defined as follows:

- *Dominant aspect* of a watershed indicates the direction of the flow of the dominant stream of a watershed.
- *Relief ratio* of a watershed is a number that represents the difference in the elevations of the watershed divided by the watershed length.
- *Dominant slope* is a percentage that indicates the slope of the watershed by dividing the mean elevation by the watershed length.
- *Hydrologic regime* is a term that summarizes the drainage patterns of the watershed. In the case of the Camas Creek Subbasin, the patterns are contorted, annual, parallel, rectangular, and dendritic. Contorted drainages are found in coarsely layered metamorphic rocks and annual drainages are circular drainages that may form rings

around circular underground structures, such as domes and basins. *Parallel drainages* flow parallel to one another due to the terrain characteristics and usually indicate moderate to steep slopes, and *dendritic branches* are drainages with a branch like pattern that occurs in areas with uniform rock with little folding or faulting and gentle regional slopes. *Rectangular drainages* occur when joints or faults are at right angles, while *multibasinal drainages* have multiple-depression patterns (Ritter, 1978) (ISAS, 2004).

- *Unit area runoff* is an estimate based on the Revised Universal Soil Loss Equation, a sediment model of the amount of erosion that occurs within a watershed in a single year.

1.3 Cultural Characteristics

Human activity can affect the water quality of a water body, either by directly influencing the water or by degrading the land around the water body, which, in turn, can affect the water. The following section will describe some of the human activities that may be influencing the water quality in the Camas Creek Subbasin, including land use, land ownership, cultural features, population, history, and economics.

Land Use

Rangeland is the major land use in the Camas Creek Subbasin followed by dryland agriculture. Other land uses within the subbasin include forest, water, irrigated - gravity flow and sprinkler, and riparian (Table 11 and Figure 12) (ArcView Coverage 1992-1996).

Table 11. Land use of the Camas Creek Subbasin.

Land use	Area (km^2)	Percent of subbasin
Rangeland	1115.1	62.8
Dryland agriculture	534.5	30.1
Irrigated - sprinkler	56.8	3.2
Irrigated – gravity flow	39.1	2.2
Riparian	14.2	0.8
Forest	8.9	0.5
Water	5.3	0.3

[a]Data from ArcView Coverage 1992-1996.

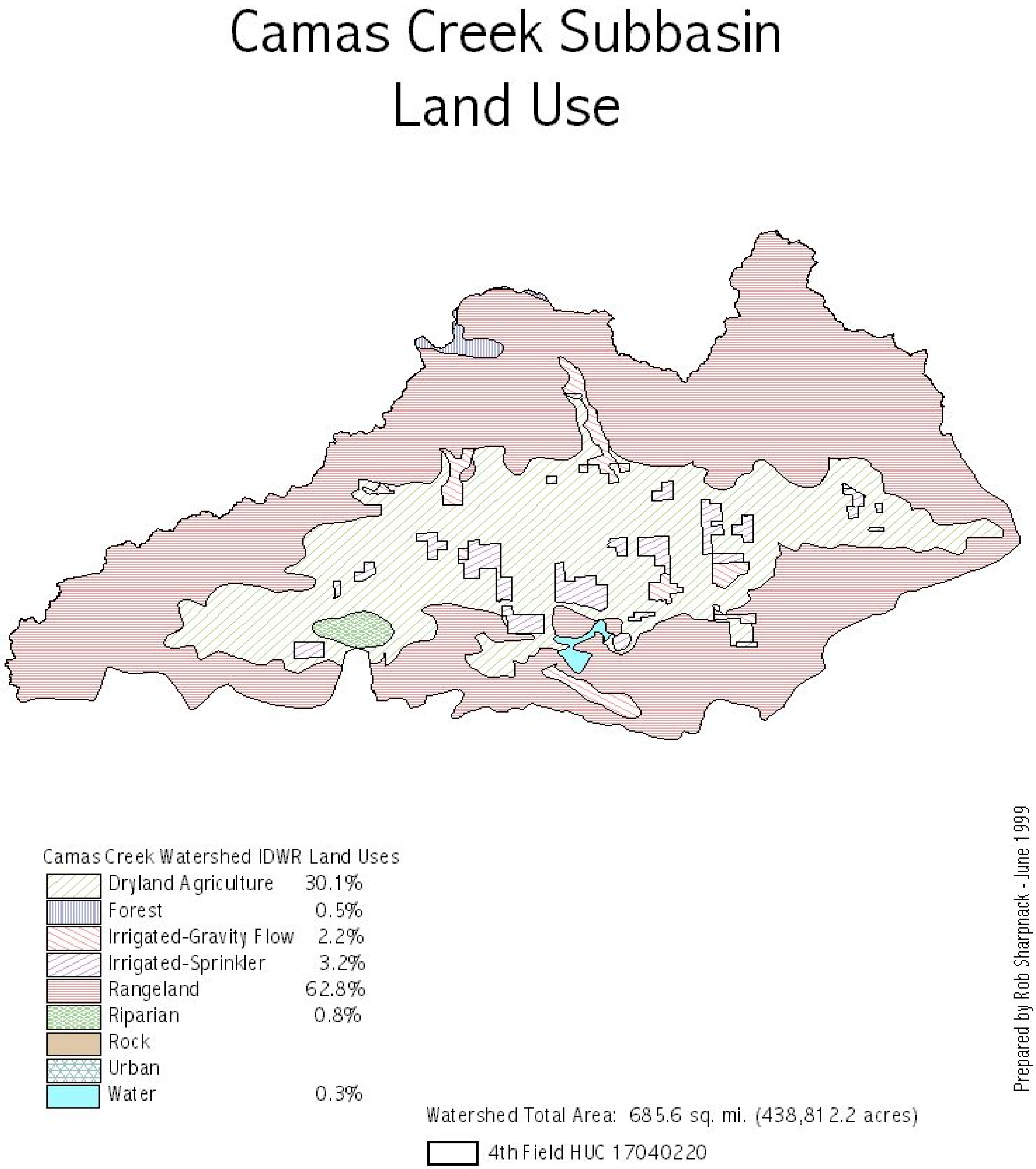


Figure 12. Land use of Camas Creek Subbasin.

Land Ownership, Cultural Features, and Population

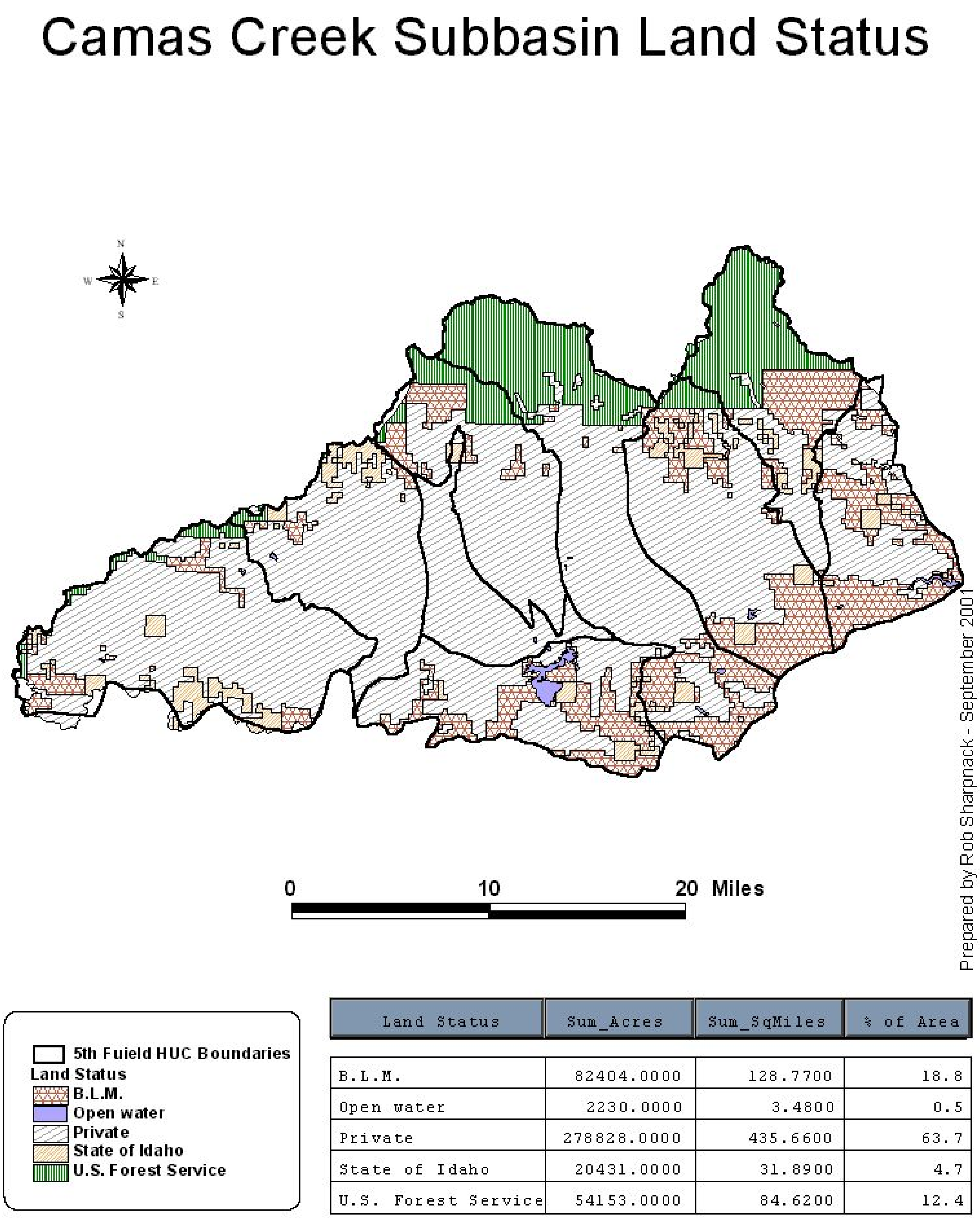
Most of the land ownership in the Camas Creek Subbasin is private, followed by public lands that are federally managed. The state also manages portions of the public land within the subbasin (Table 12 and Figure 13) (ArcView Coverage 1992-1996).

Table 12. Land ownership in the Camas Creek Subbasin.

Land use	Area (km^2)	Percent of subbasin
Private	1,128.5	63.7
BLM	333.6	18.8
USFS	219.1	12.4
State	82.6	4.7
Open water	9.1	0.5

[a]Data from ArcView Coverage 1992-1996.

There are four counties, two cities, and one historical city that exist in the Camas Creek Subbasin (Figure 14 and Figure 15). The majority of the Camas Creek Subbasin lies in Camas County (78.6% of the subbasin area); this county includes the three cities: Fairfield (19 miles west of the mouth of Camas Creek, on Highway 20, and is built up along Soldier Creek), Hill City (13 miles west of Fairfield and lies just west of Cow Creek on Highway 20), and Corral (a historical town that no longer exists). Smaller portions of the subbasin lay in Elmore County (15.1%), Blaine County (6%), and Gooding County (0.3%) (ArcView Coverage 1992-1996). The population for the Camas Creek Subbasin is estimated at 1,351 people. Seventy one percent of the total population is rural. In the last 10 years, the population of the Camas Creek Subbasin has increased 28% (IDOC 2001).



Land Status	Sum_Acres	Sum_SqMiles	% of Area
B.L.M.	82404.0000	128.7700	18.8
Open water	2230.0000	3.4800	0.5
Private	278828.0000	435.6600	63.7
State of Idaho	20431.0000	31.8900	4.7
U.S. Forest Service	54153.0000	84.6200	12.4

Figure 13. Land ownership of the Camas Creek Subbasin.

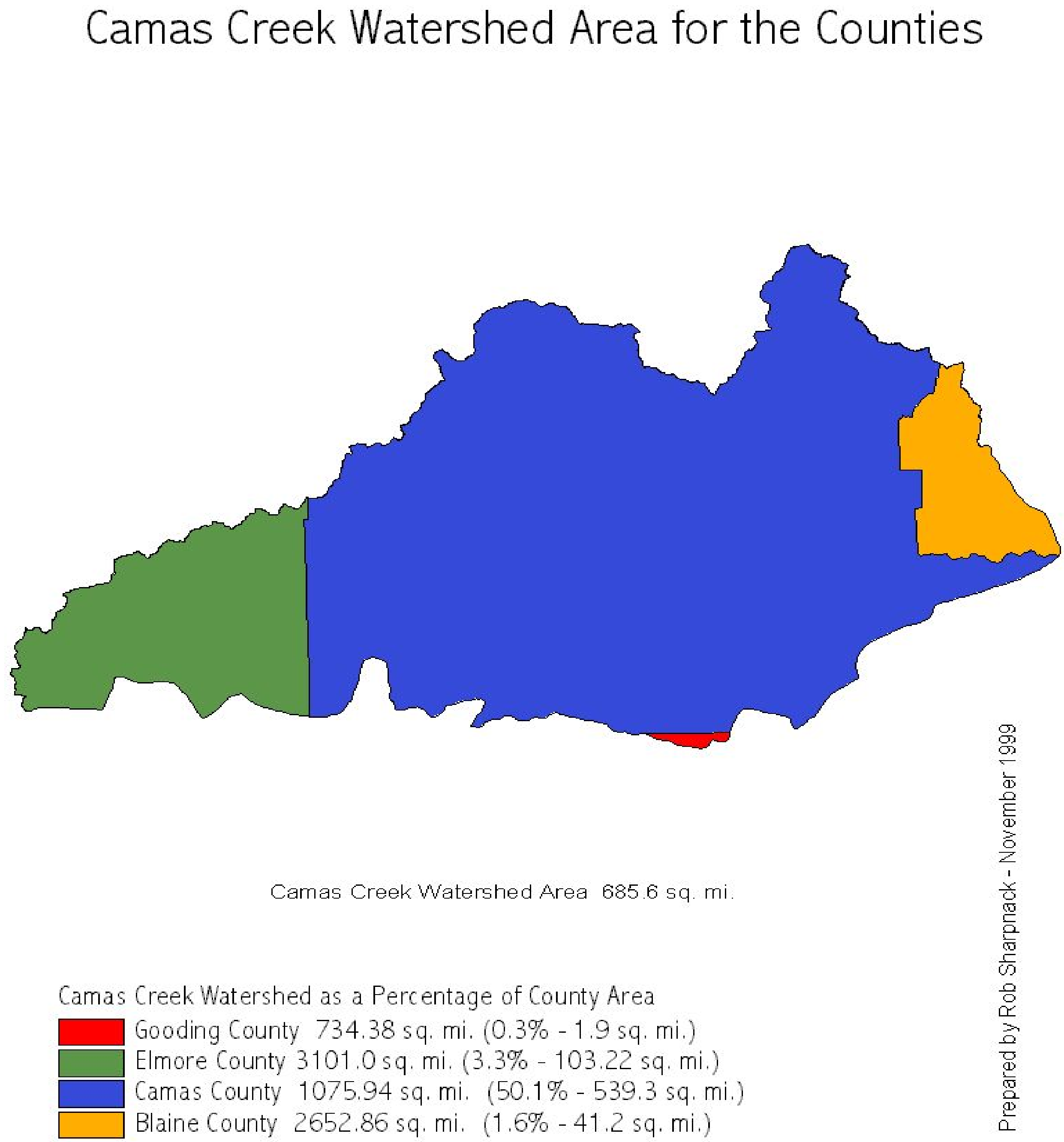


Figure 14. Counties of the Camas Creek Subbasin.

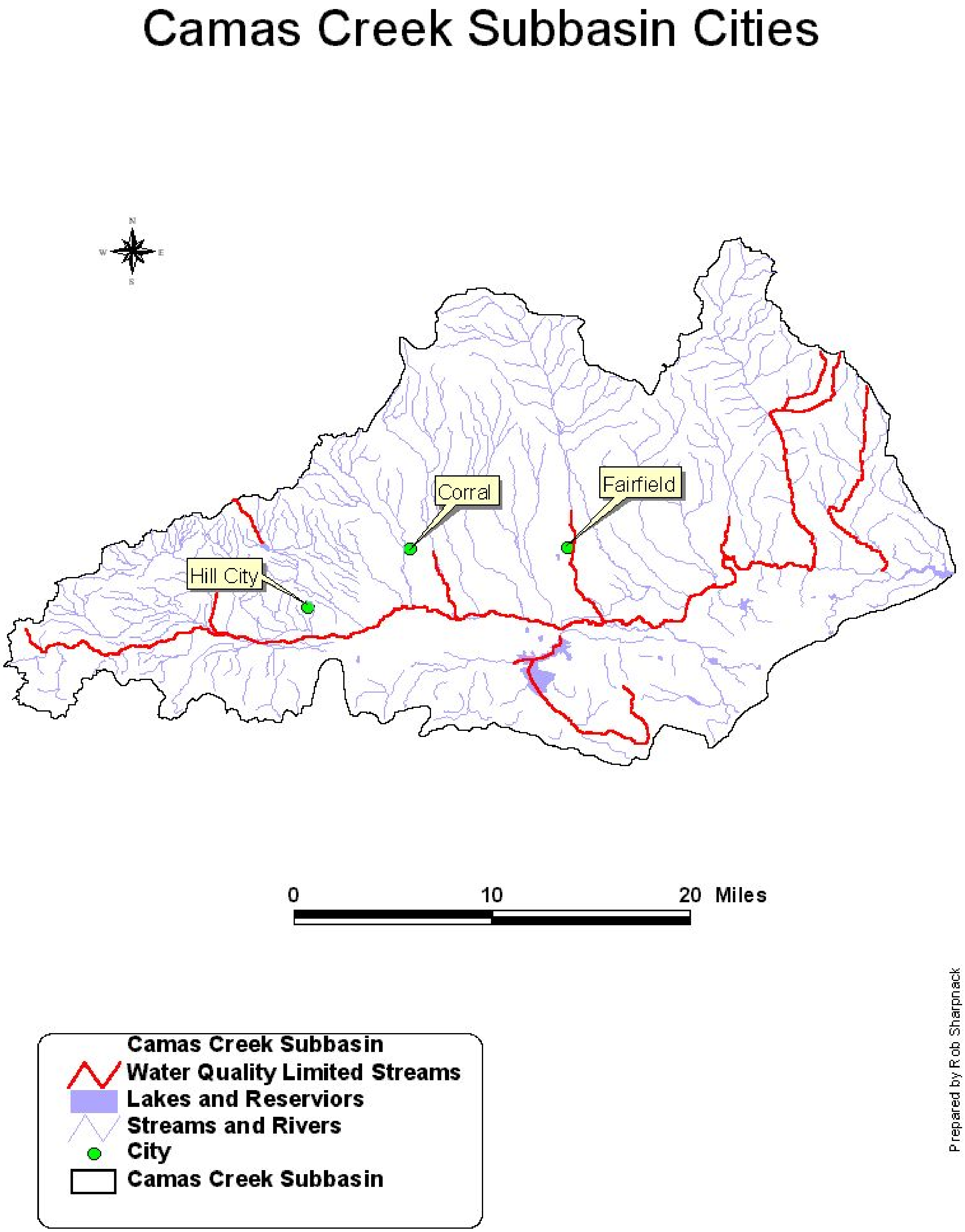


Figure 15. Cities of the Camas Creek Subbasin.

History and Economics

The Camas Creek Subbasin is predominately an agriculture region. Outside of the farming community the largest employers are Soldier Mountain Ski Area, Camas County School District, and Camas County Government. Wholesale and retail trades make up the third largest economic sector of the subbasin, led only by agriculture and government (IDOC 2001).

The majority of the subbasin lies in Camas County which has, over a 10 to 20-year span, shown a decrease in farming and cattle inventories, but an increase in retail trade and government. The other counties within this subbasin also show similar trends, however, there has been an increase in cattle inventories (Table 13).

Table 13. Agricultural statistics in the counties of Camas Creek Subbasin.

County & Year	Total number of Farms	Total Acres Farms	Average farm size (acres)	Total farms in crops	Total acres in crops	Cattle and calves in inventory	Number of irrigated farms	Number of irrigated acres
Blaine								
1987	221	246,774	1,117	193	75,191	27,474	173	54,441
1992	221	266,293	1,205	182	75,250	29,527	179	64,283
1997	195	214,985	1,102	163	70,233	26,849	160	56,909
Percent change	-11.8	-12.9	-1.3	-15.5	-6.6	-2.3	-7.5	4.5
Gooding								
1987	729	239,328	328	644	128,133	83,961	621	107,793
1992	683	227,114	333	585	139,228	113,347	581	115,398
1997	675	220,362	326	529		140,974	542	112,665
Percent change	-7.4	-7.9	-0.6	-17.9	8.7	67.9	-12.7	4.5
Camas								
1987	117	174,842	1,494	101	111,528	9,431	40	13,535
1992	93	129,490	1,392	80		7,878	28	7,486
1997	98	127,514	1,301	85	79,958	7,445	29	12,091
Percent change	-16.2	-27.1	-12.9	-15.8	-28.3	-21.1	-27.5	-10.7
Elmore								
1987	341	401,677	1,178	294		83,416	252	74,753
1992	285	353,528	1,240	237	111,390	94,298	202	75,108
1997	301	355,590	1,181	242	126,529	123,306	226	91,153
Percent change	-11.7	-11.5	0.3	-17.7		47.8	-10.3	21.9

[a]Data from Idaho Department of Commerce Website, 2001.

The City of Fairfield is the only *National Pollutant Discharge Elimination System* (NPDES) permitted facility in the Camas Creek Subbasin (Table 14 and Figure 16). Market Basket in Fairfield has had an NPDES permit, however, it is now on the city's system. The treatment train of the system is lagoons and rapid infiltration basins. The receiving water is an unnamed drainage ditch that drains into Soldier Creek and then eventually into Camas Creek. Prior to 1988 flow from the ditch reached Soldier Creek, but since this date the ditch has dried up. According to Discharge Monitoring Reports, the facility has discharged in the past very rarely. The facility has discharged from January to June of 1976, October to December of 1978, April to June of 1984, 1985, and 1988, and March of 1986 (DEQ 2004).

Table 14. Point source facilities of the Camas Creek Subbasin.

Facility	NPDES ID	Type	Design flow (mgd)	Discharge period
Fairfield	ID 002438-4	100% separated sanitary sewer	0.165	March - May

[a]Data from NPDES files at DEQ office in Twin Falls.

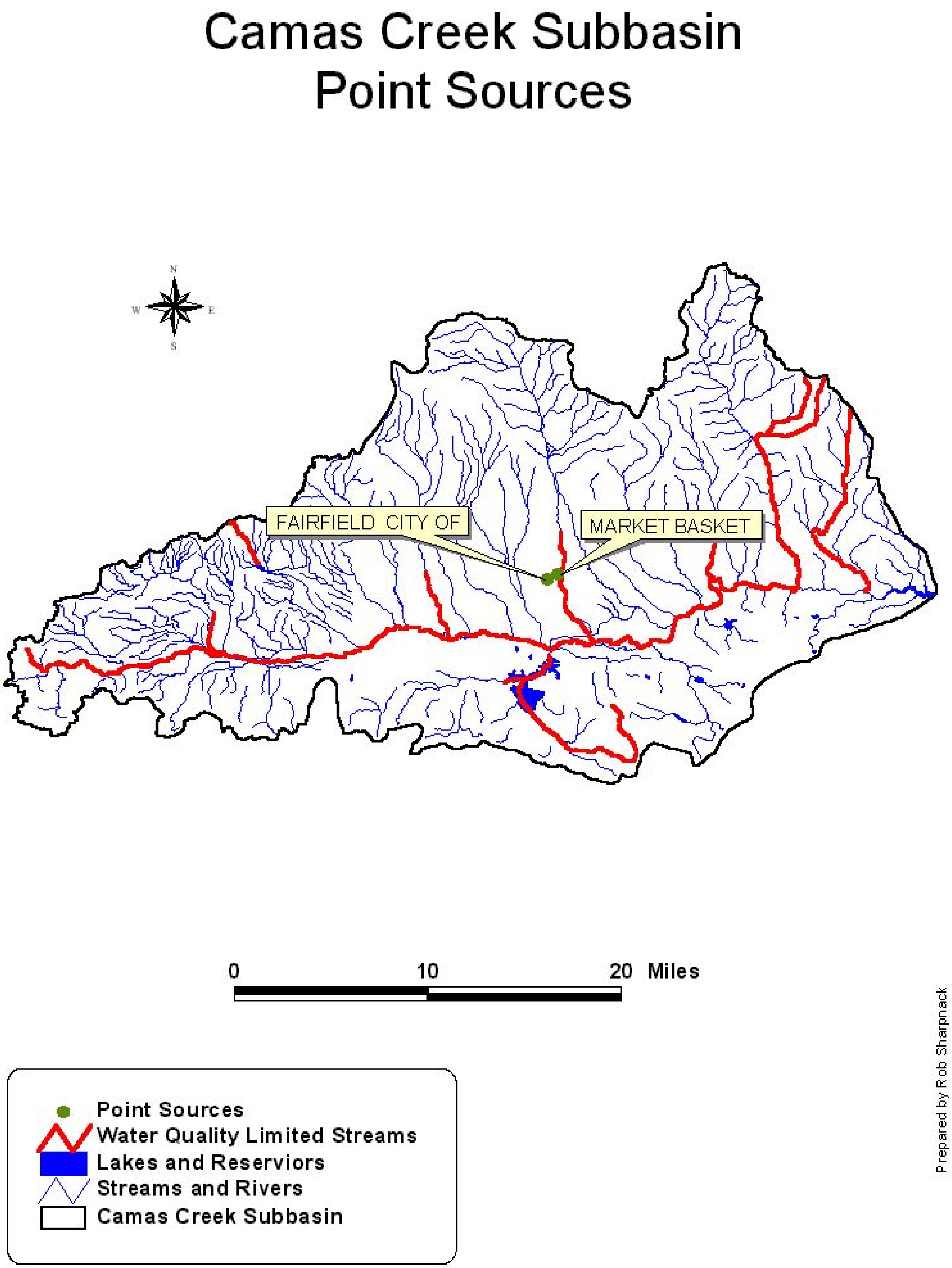


Figure 16. Point source facilities in the Camas Creek Subbasin.